The crossing point of the hyperbolae from two pairs of station measurements is solved to determine the source location estimates. This is not quite as easy as the DF approach but is simplified by obtaining an initial location estimate using a linear approximation to (9.17) and then using an iterative procedure to improve the estimate. When $\delta/x << 1$ or at long range, (9.17) can be approximated by linear equations of the hyperbola asymptotes, which pass through the midpoint of the station baseline. The asymptote slope is equivalent to an angle measurement α from the baseline at the baseline center

$$\alpha = tan^{-1}\left(\sqrt{\frac{d^2}{\delta^2} - 1}\right) \tag{9.18}$$

Another approximate angle estimate from a second baseline substituted in (9.16) simplifies the initial location estimate. The derived angles will need to be adjusted for the actual station deployment geometry and also the distance d_2 in (9.16) should be replaced by the distance between the two baseline center points. The result may sometimes be adequate, but for better accuracy, the estimate is iteratively improved based on corrections derived by substituting the approximate location x position in (9.17) for both baselines. The procedure involves determining the y values and slopes of the hyperbolae; projecting these tangents to find the coordinates of their new crossing point provides the new improved location estimate.

9.5.3 Passive Location Applet

The applet in Figure 9.10 allows realistic estimates of location accuracy for both DF and time difference of arrival (TDOA) passive location techniques. The program generates adjustable mean, Gaussian distributed angle or time delay, noise to model location errors. This approach is more realistic than the statistical method of DF location [12,13], which requires the angle variances to be small compared to the baseline subtended angle to constrain the positional errors within an ellipse. The geometry of up to three ESM stations is adjustable by mouse-clicking and dragging them to the required locations. ESM1 and ESM2 stations are moveable along the x-axis, while the third station (ESM3) can be moved up or down, off the axis and within the constraints of the x-positions of the other two stations. Similarly, the target can be mouse-clicked and dragged to any position on the screen. Scrollbars associated with the ESM stations control the mean and standard deviations of DF error data. On selecting TDOA deployments, a single scrollbar controls the magnitude of all random time errors, but different stations have uncorrelated errors. Truncated Gaussian random data is generated for each station to produce the location error plot data on the display. An estimated mean position for the current random data set is plotted on the display. ESM1 station has an associated mean timing error scrollbar. Plotted result data statistics for the current data set are summarized on the